

# FOLDING PORTABLE CELLULAR PHONE

## Background of the Invention

### Field of the Invention

5 The present invention relates to a folding portable cellular phone, and relates in particular to a folding portable cellular phone wherein, in order not to expose metal externally, an external part is formed of a material (e.g., a resin) other than metal, and metal parts that are stronger than the external part are used as a skeleton  
10 portion of a folded structure, so that productivity is improved.

Further, the present invention relates in particular to a folding portable cellular phone wherein, in order to improve productivity, a reinforcing part (e.g.,  
15 made of metal) that is stronger than an outer part (e.g., made of resin) is used only at a skeleton portion of a folded structure, while no metal is exposed on the exterior.

### Description of the Related Art

20 A feature of the conventional portable cellular phones disclosed in JP-A-9-236951 and JP-A-11-87940 is the use of a light but strong metal, such as magnesium, to form the outer exposed portion of a box shaped member.

However, when metal parts are employed for the exterior of such an object, the manufacturing process part  
25 yield is low, since the metal parts are not appropriate for

mass production. Further, because of the low yield, the manufacturing costs are increased.

In addition, a special part is required for shielding electric parts that are mounted on a substrate, such as a PCB (Printing Circuit Board), especially when shielding is required in the vicinity of a high frequency circuit that controls signal transmission and reception.

As another aspect, generally, multiple procedures, such as rust prevention, conversion treatment and visual painting, must be performed in order to use light, strong parts made of a metal, such as magnesium, for the external appearance of the box member. Since the defects, such as sink marks (pitting), crinkling (a corrugated defect), an uneven underlayer and an uneven color, are not found until visible painting and rust prevention have been completed, manufacturing yield is low. Further, since the metal part is employed to provide the external appearance of the box member, manufacturing costs are increased.

#### Summary of the Invention

To resolve this problem, a first object of the present invention is to provide a folding portable cellular phone wherein, in order not to expose metal externally, an external part is formed of a material (e.g., a resin) other than metal, and metal parts that are stronger than the external part are used as the skeleton portion of a folded

structure, so that productivity is improved.

Further, a second object of the present invention is to provide a folding portable cellular phone for which, in order to improve productivity, a reinforcing part that is stronger than an external part is employed only for a skeleton portion of the folded structure, without any metal being externally exposed.

According to a first aspect of the invention, a folding portable cellular phone, a first box member including a receiver and a second box member including a transmitter are rotated relative to each other at a hinge to permit the folding of said portable-cellular phone. Parts other than those composed of metal are employed as external parts for said first box member and said second box member. Chassis made of a metal part and including integrally formed hinges constitute skeletons of said first box member and said second box member.

With this structure, since the chassis in which the hinges are integrally formed are composed of metal parts, a high yield will be obtained during the manufacture of the external parts.

According to a second aspect of the invention, in the folding portable cellular phone of the first aspect, the metal part is made of either magnesium or an aluminum alloy.

With this arrangement, since a light, easily



unit connector is provided between portions of the hinges, which are integrally formed with the chassis, to electrically connect the first box member and the second box member.

5           With this arrangement, a satisfactory space can be obtained in which the unit connector can be provided.

          According to a seventh aspect of the invention, in the folding portable cellular phone of the sixth aspect, the unit connector is constituted by a flexible substrate and a coaxial cable.

10           With this arrangement, the flexible substrate and the coaxial cable can be freely inserted.

          According to an eighth aspect of the invention, in the folding portable cellular phone of the first aspect, in order to cover the hinges, hinge covers, which are composed of the same material as the external parts, are provided for the first box member and the second box member.

15           With this arrangement, since the shaft of the hinge is not externally exposed, no limitations are placed on the design of the portable cellular phone, and accordingly, various models can be easily developed.

20           According to a ninth aspect of the present invention, a first box member including a receiver and a second box member including a transmitter are rotated relative to each other at hinges to permit the folding of said portable cellular phone. One or both of said hinges

of said first box member and said second box member are made of reinforcing parts that are stronger than external parts and that reinforce said external parts.

According to this arrangement, since a reinforcing part, which is stronger than and reinforces the external parts is used for one or both of the hinges, the external parts can be produced at a high yield.

According to a tenth aspect of the invention, in the folding portable cellular phone of the ninth aspect, said external parts are at least one of an upper cover of said first box member and a lower cover of said second box member. The reinforcing parts are an upper hinge frame and a lower hinge frame, both including hinge portions provided respectively for said first and second box members.

According to this arrangement, since the reinforcing parts are used only for the hinge frames, the external parts are produced at a high yield.

According to an eleventh aspect of the invention, in the folding portable cellular phone of the tenth aspect, the upper hinge frame and said lower hinge frame are inserted into said external parts.

With this arrangement, the hinge frames can easily be formed for the external parts by insert molding.

According to a twelfth aspect of the invention, in the folding portable cellular phone of the tenth aspect, said upper hinge frame and said lower hinge frame are

integrally formed with a chassis that supports a substrate.

With this arrangement, the hinge frame and the chassis can be integrally formed.

According to a thirteenth aspect of the invention,  
5 in the folding portable cellular phone of the twelfth aspect, said chassis functions as an electromagnetic wave absorption member for absorbing an unwanted electromagnetic wave.

With this arrangement, the hinge frame and the  
10 chassis are integrally formed and the electromagnetic wave absorption function can be provided for the chassis.

According to a fourteenth aspect of the invention,  
in the folding portable cellular phone of the twelfth aspect, a rib is formed on said chassis in order to prevent  
15 the leakage of light at a portion in which said external parts engage.

With this arrangement, when the portable cellular phone is folded, the leakage of light can be prevented at the gap between the case covers, i.e., the portion whereat  
20 the external parts engage.

According to a fifteenth aspect of the invention,  
in the folding portable cellular phone of the twelfth aspect, a rib is formed around said chassis to reinforce said external parts that constitute said box members.

25 With this arrangement, the strength of the external parts, such as a case and a cover, can be increased.





### Brief Description of the Drawings

Fig. 1 is an exploded perspective view of the structure of a folding portable cellular phone according to an embodiment of the present invention.

5 Fig. 2 is a cross-sectional view of the folding portable cellular phone in Fig. 1 when it is closed.

Fig. 3 is a cross-sectional view of the folding portable cellular phone in Fig. 1 when it is open.

10 Fig. 4(a) is a diagram showing the structure of an upper chassis and a lower chassis when hinges are removed therefrom.

Fig. 4(b) is a diagram showing the structure of the upper chassis and the lower chassis when the hinges are attached thereto.

15 Fig. 5 is a diagram showing the state wherein an antenna is incorporated in the structure in Fig. 1.

Fig. 6 is an exploded perspective view of the structure of a folding portable cellular phone according to an embodiment of the present invention.

20 Fig. 7 is a diagram showing a structure example wherein hinge frames are integrally formed with chassis that support substrates.

25 Fig. 8 is a diagram showing an example where light leak prevention ribs are formed for the structure that the hinge frames in Fig. 7 are integrally formed with the

chassis that support the substrate.

Fig. 9(a) is a diagram showing the structure when a first reinforcing rib, which has a C shape, is formed around a chassis to reinforce exterior parts that constitute a box member.

Fig. 9(b) is a diagram showing the structure when a second reinforcing rib, which has an H shape, is formed around a chassis to reinforce external parts that constitute a box member.

Fig. 10(a) is a diagram showing the structure when a reinforcing rib, which has a C shape, is formed around a chassis and holes are formed in the chassis.

Fig. 10(b) is a diagram showing the structure when a second reinforcing rib, which has an H shape, is formed around a chassis and holes are formed in the chassis.

Fig. 11 is an exploded perspective view of a structure for the folding portable cellular phone of the invention that differs from the one in Fig. 6.

#### Detailed Description of the Preferred Embodiments

Preferred embodiments of the present invention will now be described while referring to the drawings.

Fig. 1 is an exploded perspective view of the configuration of a folding portable cellular phone according to the embodiment. In Fig. 1, the folding portable cellular phone comprises external parts, such as a

cover and a case, and an upper substrate on which electric parts are mounted, and first and second box members for which portions of a hinge are provided.

In this embodiment, the side including a receiver  
5 and a display unit (neither of which is shown) is defined as the first box member, and the side including a transmitter and a key console unit (neither of which is shown) is defined as the second box member.

The first and the second box members is coupled by  
10 the hinge, and the hinge, by permitting the two members to pivot with each other, enable the folding of the portable cellular phone at the hinge.

In Fig. 1, the first box member includes: an upper case 12, which has a window 11 for the display unit (not shown) and includes a hinge cover 13; an upper substrate 14,  
15 which is a PCB (Printing Circuit Board) on which electric parts (not shown) are mounted; an upper chassis 15, which constitutes a part of a skeleton and with which hinged portions 32 are integrally formed; and an upper cover 16,  
20 on which these components are mounted and which includes a hinge cover 17. The upper case 12 constitutes the external portion that, as a part of a portable cellular phone, attracts user attention. As for the skeleton, the upper chassis 15, with which the hinge portions 32 are integrally  
25 formed, is fixed to the upper case 12 by means such as screws or pawls.

Further, in Fig. 1, the second box member includes:  
a lower cover 22, which has a hinge cover 23 in which key  
holes 21 are formed to provide a key console unit (not  
shown); a lower substrate 24, which is a PCB (Printing  
Circuit Board) on which electric parts (not shown) are  
mounted; a lower chassis 25, which constitutes a part of  
the skeleton and which is integrally formed with hinged  
portions 32; and a lower case 26, which has a hinge cover  
27 and on which these components are mounted. The lower  
case 22 is the external portion that, as a part of a  
portable cellular phone, attracts user attention. As for  
the skeleton, the lower chassis 25, with which the hinged  
portions 32 are integrally formed, is secured to the lower  
cover 22 by means such as screws or pawls.

In Fig. 1, hinges 31 are provided as parts  
associated with the right and left hinged portions 32.  
Further, a space is defined between the hinged portions 32  
in order to permit the insertion of unit connectors (not  
shown) that electrically connect the upper substrate 14 and  
the lower substrate 24. The unit connectors are a flexible  
substrate and a coaxial cable.

Fig. 2 is a cross-sectional view of the folding  
portable cellular phone in Fig. 1 when it is closed, and  
Fig. 3 is a cross-sectional view of the folding portable  
cellular phone in Fig. 1 when it is open. As is apparent  
from Figs. 2 and 3, the upper chassis 15 and the hinged

portions 32 are integrally formed, as are the lower chassis 25 and the hinged portions 32, and a substrate is mounted on each chassis.

5 Figs. 4(a) and 4(b) are diagrams showing the structures of the chassis, which are integrally formed with hinge portions 32, as the skeletons of the first and the second box members. In Fig. 4(a), the structure of the upper chassis 15 and the lower chassis 25 is shown with the hinges 31 removed. In Fig. 4(b), the structure of the  
10 upper chassis 15 and the lower chassis 25 is shown with the hinges 31 attached.

Fig. 5 is a diagram showing the state wherein an antenna is incorporated in the structure shown in Fig. 1. In Fig. 5, a hole is formed in a part of the upper chassis 15, and an antenna 51 is attached to the upper substrate 14  
15 via an antenna ground plate 52.

In a conventional structure, since the upper cover is made of metal, and since the metal portion is located on the antenna plate side when antenna components are  
20 incorporated inside the box member, the antenna characteristics are adversely affected. However, according to the invention, since the chassis is employed to provide strength for the hinged portion, the upper cover need not be used to provide the strength for the hinged portion.  
25 Thus, the upper cover can be made of a non-metallic material (e.g., a resin), so that a portable cellular phone

can be provided which exhibits superior antenna characteristics.

Fig. 6 is an exploded perspective view of the configuration of a folding portable cellular phone according to another embodiment of the invention. In Fig. 6, the folding portable cellular phone comprises external parts, such as a cover and a case, an upper substrate on which electric parts are mounted, and first and second box members provided with a hinge.

In this embodiment, the side wherein there are a receiver and a display unit (neither of them shown) is defined as the first box member, and the side wherein there are a transmitter and a key console unit (neither of them shown) is defined as the second box member.

The first and the second box members are coupled together by the hinge, and pivot relative to each other at the hinge to fold the portable cellular phone.

In Fig. 6, the first box member includes: an upper case 112, having a window 111 for the display unit (not shown); an upper substrate 113, which is a PCB (Printing Circuit Board) on which electric parts (not shown) are mounted; an upper hinge frame 114; and an upper cover 115, on which these components are mounted. The upper case 112 is the external part that, as a part of a portable cellular phone, attracts user attention. Although not shown, the upper hinge frame 114 may be formed by inserting it into

the upper case 112, or may be fixed to the upper cover 115 by means such as screws or pawls.

Further, in Fig. 6, the second box member includes:  
a lower cover 122, in which key holes 121 are formed to  
5 provide a key console unit (not shown); a lower substrate  
123, which is a PCB (Printing Circuit Board) on which  
electric parts (not shown) are mounted; a lower hinge frame  
124; and a lower case 125, on which these components are  
mounted. The lower cover 122 is the external part that, as  
10 a part of the portable cellular phone, attracts user  
attention. Although not shown, the lower hinge frame 124  
may be formed by inserting it into the lower cover 122, or  
may be fixed to the lower case 125 by means such as screws  
or pawls.

15 In Fig. 6, a shaft 131, E-shaped snap rings 132 and  
133, and a hinge 134 are provided as hinge associated  
components in order to couple the upper hinge frame 114 and  
the lower hinge frame 124. In addition, a flexible  
substrate 135 is provided to electrically connect the upper  
20 substrate 113 and the lower substrate 123.

Fig. 7 is a diagram showing an example, unlike the  
one shown in Fig. 6, wherein the hinge frames in Fig. 6 are  
integrally formed with the chassis that support the  
substrates. Specifically, in Fig. 7, a hinge 142 is  
25 integrally formed with an upper chassis 143, and a hinge  
142 is integrally formed with a lower chassis 144. The

upper chassis 143 is inserted between the upper case 112 and the upper substrate 113 in Fig. 6, and the lower chassis 144 is inserted between the lower cover 122 and the lower substrate 123 in Fig. 6. With this arrangement, the strength of the external parts can be even more increased. Furthermore, the upper and the lower chassis 143 and 144 function as electromagnetic wave absorption members (shields) for absorbing unwanted electromagnetic waves.

Fig. 8 is a diagram showing an example wherein light leak prevention ribs 151 are formed on the structure where, as in Fig. 7, the hinge frame is integrally formed with the chassis that supports the substrate. Since light leakage tends to occur at the gap between the case covers when the portable cellular phone is folded, the ribs 151 need only be formed at a tongue-and-groove gap, so that at the portion whereat the exterior parts are engaged the leakage of light can be prevented.

Figs. 9(a) and 9(b) are diagrams showing the structures when ribs are formed around two chassis to reinforce the external parts that constitute each box member. In Fig. 9(a), a first reinforcing rib 161, which has a C shape, is formed around a chassis 162, and in Fig. 9(b), a second reinforcing rib 163, which has an H shape, is formed around a chassis 164. With this arrangement, the strength of external parts, such as a case or a cover, can be increased.



Figs. 10(a) and 10(b) are diagrams showing the structures, as in Figs. 9(a) and 9(b), whereon ribs are formed around two chassis to reinforce the external parts that constitute box members and holes are formed in the chassis. In Fig. 10(a), holes are formed in a chassis 172 around which the first reinforcing rib 161, which has a C shape, is formed, and in Fig. 10(b), holes are formed in a chassis 174 around which the second reinforcing rib 163 which has an H shape, is formed. The holes are formed in the chassis to reduce the weight of the box members and to obtain the necessary heights for the parts.

Fig. 11 is an exploded perspective view of another structure for the folding portable cellular phone according to an embodiment of the present invention. The differences between this structure and the one in Fig. 6 are that a substrate is accommodated in the chassis, and that an independent hinge is securely fixed to the chassis by a screw. The other portions of the structure are the same as those in Fig. 6. It should be noted, however, that the shaft and the hinge are attached in a different direction than is the hinge in Fig. 6.

In this embodiment, multiple hinged portions are provided for the upper hinge frame and the lower hinge frame. However, only one hinged portion may be provided for the upper hinge frame and the lower hinge frame.

With this structure, since there is only one hinged

portion, another part, such as a camera, can be mounted at a location corresponding to that whereat the other hinged portion would be installed.